Director of
Central
Intelligence

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Management and Development of Soviet Military Technology [redacted] 25X1

National Intelligence Estimate
Volume I—Key Judgmemts

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NIE 11-12-87/I
July 1987

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THE NATIONAL FOREIGN INTELLIGENCE BOARD CONCURS, EXCEPT AS NOTED IN THE TEXT.

The following intelligence organizations participated in the preparation of the Estimate:

The Central Intelligence Agency, the Defense Intelligence Agency, the National Security Agency, the Federal Bureau of Investigation, and the intelligence organizations of the Departments of State, the Treasury, and Energy.

Also Participating:

The Deputy Chief of Staff for Intelligence, Department of the Army

The Director of Naval Intelligence, Department of the Navy

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NIE 11-12-87/1

MANAGEMENT AND DEVELOPMENT OF SOVIET MILITARY TECHNOLOGY

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VOLUME I—KEY JUDGMENTS

Information available as of 1 July, 1987 was used in the preparation of this Estimate, which was approved by the National Foreign Intelligence Board on 23 July, 1987.

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SCOPE NOTE

The primary goal of this Estimate is to provide sufficient information to US planners about Soviet technology and weapon system development so that they may:

— Make informed decisions today about the US weapon systems that will be needed to counter the Soviet threat through the early years of the next century.

— Gain insights about the technologies the Soviets are likely to seek from the West through technology transfer. 25X1

Thus, we have:

— Provided an overview of Soviet efforts to develop and produce major weapon, space, and military support systems.

— Assessed the Soviet process for managing technology development.

— Evaluated the status of key Soviet military and space-related technologies and indicated how technology transfer may enhance that status.

— Judged the time when the technologies have or will become available for use in Soviet development of military systems.

— Judged what systems the Soviets *could* choose to develop based on our understanding of their management approaches and status of technologies, but not what systems the Soviets *will* field. 25X1

Since the last issuance of NIE 11-12 in 1983, we have gained new and deeper insight into how the Soviets manage the incorporation of technology into their weapon development process. This has been a major factor in improving our ability to understand the early phases of Soviet weapon development programs and, consequently, our ability to forecast when new systems could be available for deployment. We have also gained insight into how the Soviets manage their high-technology research programs. Thus, we are now in a better position to evaluate whether new equipment is part of a technology development program or a system development program. 25X1

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NOTE

This Estimate is issued in three volumes:

— ***Volume I*** contains the Key Judgments.

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This information is Secret

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KEY JUDGMENTS IN BRIEF

• We believe that future Soviet military systems will continue to compete effectively in overall capability with US systems during the next 15 years because of:

— Effective R&D management practices.

— Prompt incorporation of technology into military system designs.

— Extensive use of foreign technology.

• Soviet leaders recognize that technology plays a major role in determining the USSR's future military weapon and space capabilities. We now know that Soviet planners are well informed about the status of technology in development and are likely to specify the best available technology when they generate design requirements for new or improved military systems. Despite technology lags and production deficiencies when compared with the West, Soviet technology in many areas is better than we had previously estimated.

• Direct comparison of US and Soviet technology is inadequate to make judgments on the quality of projected weapon systems and can be misleading.

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• Soviet leadership supports a large and stable base for conducting R&D that provides for continued improvement of military systems. They have allocated a steady high level of R&D funding over long periods.

• The Soviets use a schedule-dominant management approach for systems development and do not normally try to accelerate military

programs from established norms. We have observed no significant exception to date. We are concerned, however, that a key technology transfer or advance could allow an earlier program start than otherwise possible for a high-performance system that would reach the field sooner than anticipated.

• The Soviets have placed a high priority on improving their weak production base and have had some success in increasing their pace of technology through:

— Use of a "follower" research strategy.

— Use of a "goal-oriented" program management approach for some technologies.

— Use of technology transfer to supplement weak areas.

These successes may sacrifice long-term indigenous developments.

• Soviet military planners act on early knowledge of Western programs to copy key technical features in their new designs and to offset expected Western advances.

• The major portion of Soviet systems which are deployed in the 1990s and early 2000s will involve evolutionary improvements in the types of systems now in service. A small portion of the new systems will provide capabilities new to the Soviets.

• Our ability to determine Soviet advances, which will result in a "technological surprise," is likely to be mixed. Based on what we now know about the current status of Soviet science, technology, and their acquisition process, the probability of a Soviet revolutionary deployed capability in the next 15 years should be low. This is because of the long time it would take the Soviets to transition any breakthrough into deployed systems. Despite these insights the probability of errors in projections remain. We continue to be concerned that the Soviets may make scientific or technical advances that either we miss or are unable to assess or may make an innovative application of current technology that could result in an unanticipated Soviet capability.

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KEY JUDGMENTS

We believe that future Soviet military systems will continue to compete effectively in overall capability with US systems during the next 15 years because of:

- **Effective R&D management practices.**
- **Prompt incorporation of technology into military system designs.**
- **Extensive use of foreign technology.**

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Soviet military research and development capabilities and practices can produce systems competitive with both existing and future US military systems, even though they lag the West in many important technologies. The way the Soviets conduct R&D poses multiple threats for long-range US weapon and technology planning, despite the gains in system performance the United States expects to make by applying technologies in which we lead the USSR:

- The Soviets have established a large, varied infrastructure that provides the foundation for the frequent, evolutionary improvements to operational military systems and has produced steadily improved military capabilities in the field. We are confident that this will continue at least through the end of the century.
- Military requirements drive Soviet research and development activities to a large extent. Development of technology has been pursued with the objective of closing the gap between the performance of their fielded military systems and their military mission requirements. The result has been steady progress in the performance of new systems toward stated goals. Within the last decade, we have noted the introduction of several new management approaches to technology development that seek to further integrate research, design, and production of systems to reduce longstanding problems in transitioning from technology development to production in the Soviet Union. We believe new Soviet military systems continue to benefit by timely and practical application of the best available technology to their design—as a result of either indigenous research or by application of technology acquired from the West.

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— Systems development—The Soviets have a well-organized planning and acquisition system for weapons and space development programs. They minimize the cost and risk of new systems development by using an approach that incorporates proven technologies. Further the Soviets use continual incremental updating of weapon systems to achieve required military performance levels. 25X1

Soviet leaders recognize that technology plays a major role in determining the USSR's future military weapon and space capabilities. We now know that Soviet planners are well informed about the status of technology in development and are likely to specify the best available technology when they generate design requirements for new or improved systems. Despite technology lags and production deficiencies when compared with the West, Soviet technology in many areas is better than we had previously estimated. 25X1

We have, thus, included in this Estimate our assessment of what technologies are now available to planners for starting new military system development programs and what technologies are expected to become available during the next 10 years. We caution readers of this Estimate that the availability of key military technologies provides the Soviets with *options* for system development. 25X1

In most areas of technology the Soviets lag the United States. The number of technology areas where the Soviets lead or are equal to the United States has not changed significantly since our last Estimate. We found, however, many specific technologies where they are ahead or closer to the United States than we previously believed. Specific technologies were developed to compensate for Soviet shortcomings in other technologies where the Soviets lag the West. 25X1

Technology areas where the USSR continues to lag the United States include microelectronics, computing, signal processing, communications, ASW, electro-optics, infrared sensors, manufacturing technology, and genetic engineering. Despite these lags Soviet progress in these technology areas will allow them to enhance the performance of future military systems. 25X1

Technology areas where the USSR continues to lead the United States include chemical warfare and explosives. They also lead in many specific technologies including: titanium metallurgy and welding, some high-energy lasers, charged and neutral particle beam related technology, millimeter wave (radiofrequency) power sources, cassegrain radar antennas, and gallium-arsenide space solar cells. They continue to pursue technology subareas where US effort has slowed in recent years including: liquid fluorine rocket propulsion, nuclear rocket propulsion, and space nuclear power sources, for example. 25X1

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The Soviets appear superior to the United States in deployed armor/antiarmor technology. They have surpassed the United States in some technology areas of hypervelocity impact research—a key field for developing nonnuclear kinetic energy weapons. They could be on a par with the United States in various nonnuclear kill devices. They are ahead in available magneto hydrodynamics (MHD) and are world leaders in available magnetocumulative generator (MCG) power sources.

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In some areas where the West is using a technology to make major weapon system performance gains and where the Soviets are lagging, the Soviets are using compensatory technologies to make up for shortfalls. In some of these compensatory technologies the Soviets have established technical leadership. Examples include: the use of storable liquid propellants rather than solid propellants for ballistic missiles; using cassegrain radar antennas rather than slotted plate antennas in tactical aircraft avionics subsystems; optical processing to help make up for an overall lag in signal processing, and the development of stellar sensors and hydrostatic gyroscopes to make up for their lag in other guidance and navigation technology areas.

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The rapid pace of advancement of microelectronics and computing technology permits the design of ever more complex military systems. In the ability to volume produce microelectronics, for example, the United States holds a technological edge of eight to nine years over the USSR and that lead is increasing steadily. Comparing the *application* of microelectronics to military systems in the United States and the USSR shows the US lead significantly less than that noted above. This is due to Soviet application of new generation microelectronics to designs when pilot production is achieved. There is another view that believes Soviet designers are quite conservative when selecting new generations of microelectronics to apply in new and upgraded systems. They are acutely aware of the production shortcomings of the Soviet microelectronics industry and have shown a tendency to wait until new generations of microelectronics are in full production before assimilating them into their weapons designs.[1]

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The Soviets will pursue their goals of parity or superiority in deployed systems by staying close behind the United States in technologies where they lag, by promptly applying new technologies to military system development as they become available, and by improving their industrial base for military system design and production.

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[1] *This view is held by the Director, Defense Intelligence Agency.*

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The Soviets are continuing to improve the way that they manage technology development for their military systems—a process that they began in the late 1960s. The Soviets supplement their military technology base by acquiring technology from the West and by using compensatory technologies in those areas where they are the weakest, they often use innovative designs to attain performance goals when technical levels are not available. This has resulted and should continue to result in increasing the Soviets' ability to bring their technology to maturation and to develop military systems competitive with the West.

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Direct comparison of US and Soviet technology is inadequate to make judgments on the quality of projected weapon systems and can be misleading.

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Current and future generations of many US and Soviet weapon systems compare more closely in quality than do their technology bases. This is due in part to the Soviet management of weapons development, the frequency of Soviet system modernization and early knowledge of Western system characteristics, which allow the Soviets to undertake competitive system designs on schedules responsive to the United States.

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The continual Soviet application of advanced technology to the large numbers of new programs they conduct each decade has major implications for the performance advantage the US expects to gain by applying advanced technology in its systems. The Soviets have a comparative advantage over the United States in the time it takes them to make decisions to commit resources for developing new systems. Over the past 30 years, our analysis shows the Soviets requiring about three to five years to decide on a specific model to develop after they identify a military requirement. This allows the Soviets to quickly apply their latest technologies (including those acquired through technology transfer), even though they may lag the United States at the time, to new programs shortly after they mature for military applications. Thus newly developed or acquired technologies have often been applied more quickly in the USSR than in the United States.

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Key New Insight—Soviet Technology "Maturity"

We believe a key analytical advance made in this Estimate is our new insight to the status a technology must achieve before the Soviets select it for incorporation into military system designs. The new insight significantly affects our judgments throughout this Estimate and changes many previous judgments. We now believe we can and must carefully differentiate between Soviet military-related or sponsored technology developments and military system developments. The status of Soviet technical advances can provide better insights as to when technology developments can affect Soviet military system performance capabilities that will threaten the United States or US military systems.

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We believe that after a technical phenomenology has been proved in a laboratory the Soviets will prove its technical feasibility through testing, and prove its producibility before applying it to new or improved products. When a technology is intended for a military product the military will conduct further testing to demonstrate feasibility. When the technology and the system application are new and unique, a system concept feasibility demonstrator may also be built and tested. Such feasibility testing is likely to occur at a military test range.

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Soviet design standards now call for technology to be proved feasible before application to preliminary designs for choosing a model to build in the full-scale engineering phase of this acquisition cycle. Before proceeding to system development the technology must be proved producible by the successful establishment of pilot production. Technologies achieving pilot production are deemed "mature" by the Soviets and military system development on normal schedules can follow.

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There are alternative views that hold that the Soviets have other criteria that must be considered to assess when microelectronics and laser technologies are or were selected by designers for incorporation in specific weapon systems.

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The Soviet "Caspian-Sea-Monster" wing-in-ground effect (WIG) vehicle was believed to be a system prototype when initially seen in the 1960s and a mid-1970s operational capability was projected. The early WIG vehicles were in fact feasibility demonstrators, and program decisions were not made by the Soviets until the mid-1970s. Initial operational WIG vehicles will be deployed in the late 1980s and early 1990s. Also, technology development for the Soviet AWACS was funded in the late 1960s and its mid-1970s design was based on those results that were optimized to improve detection of low flying bombers. The initial SU-AWACS has marginal capability against the US cruise missile, which entered development in the mid-1970s, but technology maturing for 1980s will allow them to begin an upgrade program for that threat.

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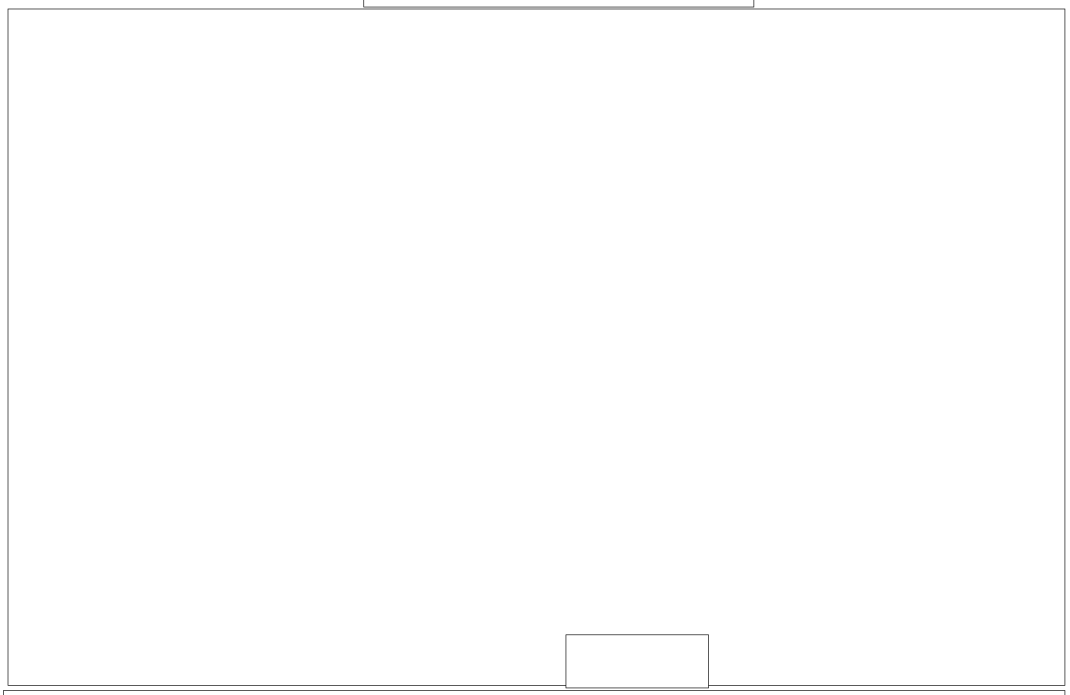

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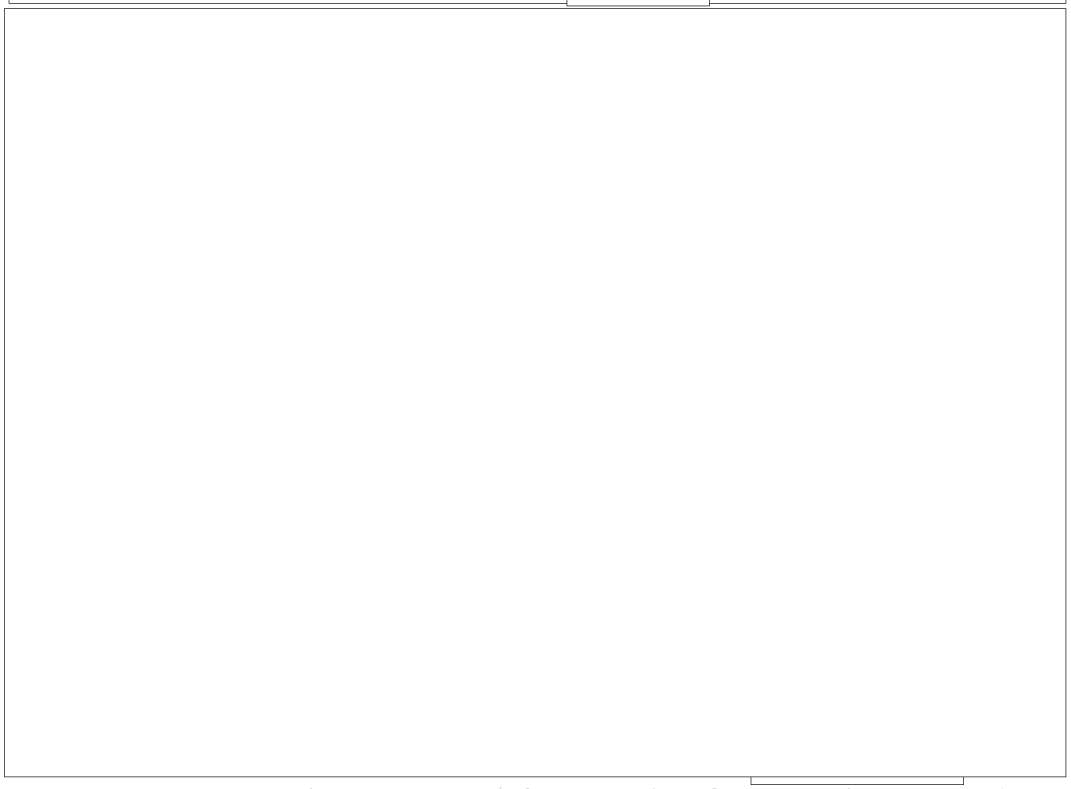

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Soviet leadership supports a large and stable base for conducting R&D that provides for continued improvement of military systems. They have allocated a steady high level of R&D funding over long periods.

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To develop the large numbers of military programs the Soviets have chosen to pursue per decade as technology becomes increasingly complex, they have been steadily increasing the resources they allocate

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to military R&D. For example, they have increased the number of military-sponsored research projects they conduct per year from about 4,000 in the 1970s to about 5,000 in the 1980s. Moreover, their estimated manpower devoted to RDT&E has about doubled since 1965. Finally, we estimate the physical growth in facilities at 1,500 organizations associated with military RDT&E increased from 1965-84 at an average rate of about 3 percent per year.

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The tightening pinch in Soviet labor, capital, and natural resources and the accelerating advance of leading Western technologies are causing the Soviets additional problems. These larger problems ensure that the Soviets will continue to require substantial amounts of Western technology and equipment. Moscow's drive to acquire and assimilate technology, therefore, almost certainly will intensify through the remainder of the 1980s, as will its efforts to improve the mechanisms involved.

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The Soviet research base is broad and diverse. The Soviets have emphasized research in areas that are not emphasized in the West or have taken divergent paths from those of the West. The possibility of unanticipated results, surprising applications or novel approaches cannot be ruled out. These possibilities are of concern whenever Soviet research leads or diverges significantly from that of the West.

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The Soviets have sustained a high and steady rate of systems development for the last 30 years despite fluctuations in Western military programs and budgets, arms control, and internal economic problems. We believe over the long term their large research effort will provide Soviet designers and military planners with more flexibility, when required, to go beyond evolutionary upgrades in meeting operational shortfalls, new threats, and taking new mission area initiatives. The Soviet leadership has made decisions to reallocate or change emphasis in weapon system and technology development areas that they believe will provide them with political advantages or opportunities in the future. For example, the Soviets made decisions in the mid-1970s to reemphasize bomber and strategic cruise missile development and to expand their space program. Decisions to support the larger cruise missile and space programs coincided with cutbacks in their ICBM and SAM programs. Moreover, they assigned ABM and early warning radar system managers to direct new technology development—primarily in the directed energy area.

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Despite their ability to prioritize and focus their military technology and system development efforts in key areas vital to their national defense, the technology of Soviet deployed systems has often lagged behind their requirements. If the Soviets were capable of doing so we would have expected them to move faster in developing a response to

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the US cruise missile program, an effective real-time space reconnaissance capability, bomber defenses as US penetration strategy changed, and an effective submarine detection capability. In the past the Soviets have often dealt with this problem by deploying (in large numbers) systems that fell short of their needs and then programed repeated, incremental improvements during the lifetimes of such systems. The Soviet strategy to slow the progress of the US Strategic Defense Initiative (SDI) is motivated, at least in part, by their view of the timetable they can achieve building counter and counterpart systems to the US SDI capability potential.

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The Soviets use a schedule-dominant management approach for systems development and do not normally try to accelerate military programs from established norms. We have observed no significant exception to date. We are concerned, however, that an observed key technology transfer or advance could allow an earlier program start than otherwise possible for a high-performance system that would reach the field sooner than anticipated.

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The Soviets use a schedule-dominant management approach to develop military systems and we do not expect them to change this approach. Technology selection occurs early in a schedule-dominant management style—before the full-scale engineering phase. This management approach, similar to that used by US corporations for the development of large commercial systems, is one in which meeting a predetermined delivery date takes precedence over changing the system's design during development. Normal Soviet development time for major new military systems averages 12 to 15 years; major system improvements or conversions average eight to 10 years; and minor system improvements or conversions average five to seven years. These average development times have not changed since the late 1950s.

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They regularly plan the use of inputs from their technology transfer acquisition program to supplement their indigenous military technology development efforts. This allows them to truncate indigenous military research when targeted Western technology is acquired and begin system development programs earlier than expected. They are often able to incorporate technology into a weapon system development program, shortly after the United States achieves full production, but it takes them longer to achieve full production.

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The Soviets complete a high percentage of their weapon system development programs. About 350 military weapons, space, and support system development programs are conducted per decade. About 200 of these are for military systems that are new (about 85 to 100 per decade) or significantly improved or converted (100 to 115 per decade), and the remaining 150 are for systems with minor technical improvements or minor conversions of existing systems. *To offset the cost*

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growth inherent in developing and producing more technologically complex weapons, the Soviets plan to increase productivity in their defense industry. As costs and capabilities rise, we see a trend toward reducing the quantities of advanced technology military systems produced and deployed.

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The development time for Soviet military systems is not reduced by implementing what the United States would consider a "crash" program. When the Soviets describe a program as "accelerated," their aim is to hold to the normal schedule even when a project is difficult or complex. When a Soviet program is described as "priority," that should be interpreted to mean that it is allowed first call on resources rather than to speed up the program. The Soviets have used their conservative approach in selecting technology for use in a new military system development since the late 1960s. They wait until a technology has proved to be producible before beginning full-scale military system development. The Soviets tried some programs in the late 1950s and early 1960s where they selected technologies before they were proved and had major failures, for example, the SL-X-15 large space booster and the TU-144 supersonic transport. As a result, to reduce the number of failures they incur they reemphasized a conservative management style after the mid-1960s.

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The Soviets have placed a high priority on improving their weak production base and have had some success in increasing their pace of technology through:

- **Use of a "follower" research strategy.**
- **Use of a "goal-oriented" program management approach for some technologies.**
- **Use of technology transfer to supplement weak areas.**

These successes may sacrifice long-term indigenous developments.

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The Soviets use various management approaches to overcome some of their technical shortfalls. They conduct frequent system upgrade programs incorporating new technology. The Soviets now permit planned requirement generation and early design of new military systems when a technology has proved feasible. The Soviets will introduce a technology or component into the full-scale engineering phase of military system development when they have confirmed its producibility.

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Another part of the improved Soviet management of defense planning has been to establish a national program to forecast technologi-

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cal developments that are closely tied to their major military mission areas. The forecasts project 20 to 30 years ahead and guide current planning of technology development in an attempt to ensure that technologies applicable to military requirements are not overlooked.

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The Gorbachev regime is seeking to improve productivity throughout the economy by modernizing and automating the entire Soviet industrial base. This is an extension of the intense program to modernize the defense industrial sector during the 1970s and early 1980s, which allows the Soviets to produce new generations of advanced military hardware. If successful—and there are many impediments to meeting their goals—the Soviets will be well positioned to continually update their defense industrial technology because of the improved underlying civilian industrial base. Soviet industry should, by the mid-1990s, after 20 years of modernization programs—including those of Gorbachev's predecessors—retooling, and management shifts, be more capable of more rapidly assimilating high technology in many military products without significant delays during transition to production. Because the quality and depth of engineering and, particularly, industrial capability change slowly, the Soviet areas of deficiencies will probably persist over the next 10 to 15 years. Furthermore, the accelerating pace of Western advances in such areas as microelectronics and computing will probably frustrate their efforts to achieve self-reliance.

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Through the use of the new goal-oriented technology program management style, the use of a follower-research strategy and extensive technology transfer from the West, the Soviets have shortened or accelerated the time for certain technology (not military system) developments. This has allowed them to begin military system development programs earlier than if they used previous management practices and relied solely on indigenous research. New systems have thus reached the field earlier—but not as the result of shortening the military system development schedule. We do not believe the Soviets plan to use foreign parts in weapons. The Soviets competition with the West in military systems will intensify their drive to acquire Western technology and assimilate new technology levels achieved indigenously through the remainder of the 1980s. We also expect they will attempt to improve their mechanisms for technology transfer.

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Technology transfer from the West continues to provide the Soviets with an expanding technology base. There are two ways the Soviets supplement their indigenous technology needed for weapon systems: (a) by free-world market volume acquisition through illegal trade diversion of manufacturing and test equipment for direct use in production lines; and (b) by acquisition of one-of-a-kind hardware and blueprints primarily through the espionage program for design through reverse

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engineering and copying, and overcoming technical obstacles that were slowing down their progress by learning from Western design solutions. Characteristics of these programs overlap. 25X1

Western technology is used to supplement indigenous technology in both design and production/testing of weapon systems. Analysis of available Soviet technology transfer requirements shows that about 75 percent is for acquisitions of production and test equipment and that about 20 percent is for design and basic technology. To apply Western technology that will affect the performance of a new weapon system would require the Soviets to assimilate the technology before their earliest design phase begins. To apply Western production technology the Soviets plan for acquisitions before decisions to begin engineering development, but acquisitions and installation may occur up to the time of production line startup. 25X1

Technology transfer from the West has allowed the Soviets to shorten technology development programs. Applying Western technology to their military programs yields significant savings in program costs, frees indigenous R&D resources for efforts in other areas, and enables the Soviets to develop and produce more capable military systems at earlier dates than would otherwise be possible. Given the length of full-scale development and test programs, the time required for foreign technology acquisitions that affect military system performance to impact deployed military capability probably ranges from five to 15 years. New systems would be closer to the high end of this range and modernizations of existing systems would typically be toward the low end. 25X1

Reliance on the technology transfer from the West has a downside, in that it tends to impede indigenous development. The USSR's practice of reverse engineering may cause the Soviets problems, as US and Japanese integrated circuits, for example, become more complex. 25X1

To compete in certain advanced technology areas, the Soviets established in the 1960s centrally managed, goal-oriented technology development programs. These programs guide Soviet efforts from the emerging scientific concept through feasibility demonstration to system development. In emerging scientific areas, like high-energy lasers and particle beams, computers, and production technologies (robotics and advanced machine tools), it takes the Soviets 10 to 25 years to develop the technology for weapons applications and another 10 to 15 years to develop and produce the weapon system that uses the technology. Their production base (particularly in microelectronics, computers and telecommunications, composite materials, and high-performance guidance and navigation subsystems) limits their ability to produce higher technology products and quickly move new designs into full production.

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Technologies the Soviets have chosen for development using their goal-oriented management style will provide them with potential future opportunities. In the mid-to-late 1960s they organized a wide-ranging directed energy research program. They began to focus on genetic engineering for biological warfare by increasing the number of research institutes twofold in the mid-1970s. And in the 1980s the Soviets have begun new research programs to develop technology for X-ray lasers, optical computers, digital minisupercomputers, new advanced types of explosives, and advanced kinetic energy systems. We do not know how long it will take the Soviets to accomplish their technology goals in all these areas, but for the most part the technical maturity to allow system development is still years away. The major military advantages that could emerge from most of these investments will most likely *not* be available for Soviet leadership to exploit until after the turn of the century. We believe the Soviet management practices that have recently served them well, goal-oriented programs, and the follower strategy have a downside to them. In the USSR's centralized economic system, goal-oriented research tends to be narrow and overdirected and leads to a lack of commitment to basic science, essential for innovation. The continued use of a follower strategy—like technology transfer—tends to impede indigenous development.

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Soviet military planners act on early knowledge of Western programs to copy key technical features in their new designs and to offset expected Western advances.

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The Soviets have been able to make decisions to develop systems responsive to many US capabilities at about the time engineering development (6.4) decisions are made and announced in the United States, whereas US system planners have been unable to obtain detailed insights into Soviet systems until late in the Soviet development cycle, usually not until the Soviets have begun to test or field their systems. Increasing numbers of expensive US systems are expected to be in operational inventories for up to 20 to 30 years. While the United States may have a performance advantage when a new system is deployed, the Soviets have been able to field systems with matching or offsetting capabilities that will be in their inventory relatively soon after US system deployments. In some cases the Soviets through early knowledge of a new US systems performance capability have been able to field competitive systems concurrently with those of the United States. We expect the Soviets to improve their relative ability to field systems that will contend well with the US systems in the early 2000s.

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The major portion of Soviet systems which are deployed in the 1990s and early 2000s will involve evolutionary improvements in the types of systems now in service. A small portion of the new systems will provide capabilities new to the Soviets.

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For example, Soviet directed energy and kinetic energy weapons-related research had considerable momentum well before the US announced the SDI program. If proven feasible, these technologies will eventually allow them to begin weapons programs to meet their own strategic defense requirements. This extensive work is likely to proceed regardless of US advances in SDI.

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Advances we expect in specific mission areas include:

— Strategic nuclear attack capabilities will improve significantly as a result of incorporating higher levels of Soviet microelectronics, propulsion, guidance and navigation (G&N), structural materials, communications, signature reduction/low observables, sensors, and sensing technology levels than they attained in previous generations.

— Strategic defense capabilities will improve with advances in radar, signal processing sensors, laser radar, laser pointing and tracking, laser power source, and directed energy technology research programs that have received significant resources over the past 10 to 20 years.

— Tactical ground warfare capabilities will continue to be an area where Soviet systems will excel as the result of structural material, conventional explosives, microelectronics, laser ranging and designation, and BW/CW technologies available for new designs in the 1980s and early 1990s.

— The majority of the improvements in aircraft will come from evolutionary technology developments. Emphasis will be on *aircraft survivability* and *weapon system efficiency*. We do not foresee significant expansions in the overall flight envelopes for combat aircraft; however, it is likely that survivability will be attained through improvements in aircraft performance and application of signature reduction technologies.

— The Soviet Navy will continue to improve the capability of its general purpose forces to protect its SSBNs, counter Western naval forces, provide support for ground operations, and disrupt enemy sea lines of communications.

— Forthcoming improvements in operational command and control capabilities will continue to stress the national command authority's more rapid and survivable control of forces and weapons. Command, control, and communications for the next decade will be limited by microelectronic and power supply technologies that are either now mature or will be in the near future.

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— We expect the Soviets to make improvements to the new space boosters they are now developing throughout the 1990s. The increased lift capabilities of these vehicles over predecessor SLVs will result in many new missions and improved capabilities over the next 20 years. 25X1

The possible new systems we believe the Soviets have the technical capability to begin engineering development programs on between the late 1970s and the early 1990s [2] are based on our current insights into:

— Current system shortfalls.

— Responses to Western initiatives.

— Perceived new system requirements.

— Research, development, and acquisition (RDA) process.

— When technologies would mature to a level that would allow the Soviets to begin the full-scale engineering development phase of their RDA process.

We cannot in all cases assess the probability that the Soviets will deploy the systems we have described based on the availability of technology. We have discussed in this Estimate many options based on technological advances from which the Soviets would be likely to choose to develop new military and space programs. *It is unlikely that they would deploy all the possible systems discussed.* 25X1

Our ability to determine Soviet advances that will result in a "technological surprise" is likely to be mixed. On the basis of what we now know about the current status of Soviet science, technology, and their acquisition process, the probability of a Soviet revolutionary deployed capability in the next 15 years should be low. This is because of the long time it would take the Soviets to transition any breakthrough into deployed systems. Despite these insights the probability of errors in projections remain. We continue to be concerned that the Soviets may make scientific or technical advances that either we miss or are unable to assess or may make an innovative application of current technology that could result in an unanticipated Soviet capability. 25X1

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[2] Technologies available in the late 1960s to late 1970s would have supported development of weapons and space systems that will be deployed in the near term—by the mid-1990s. Projections of systems that will become operational in the near term are assessed in other National Intelligence Estimates. For a list of Estimates that discuss near-term system development see annex 25X1

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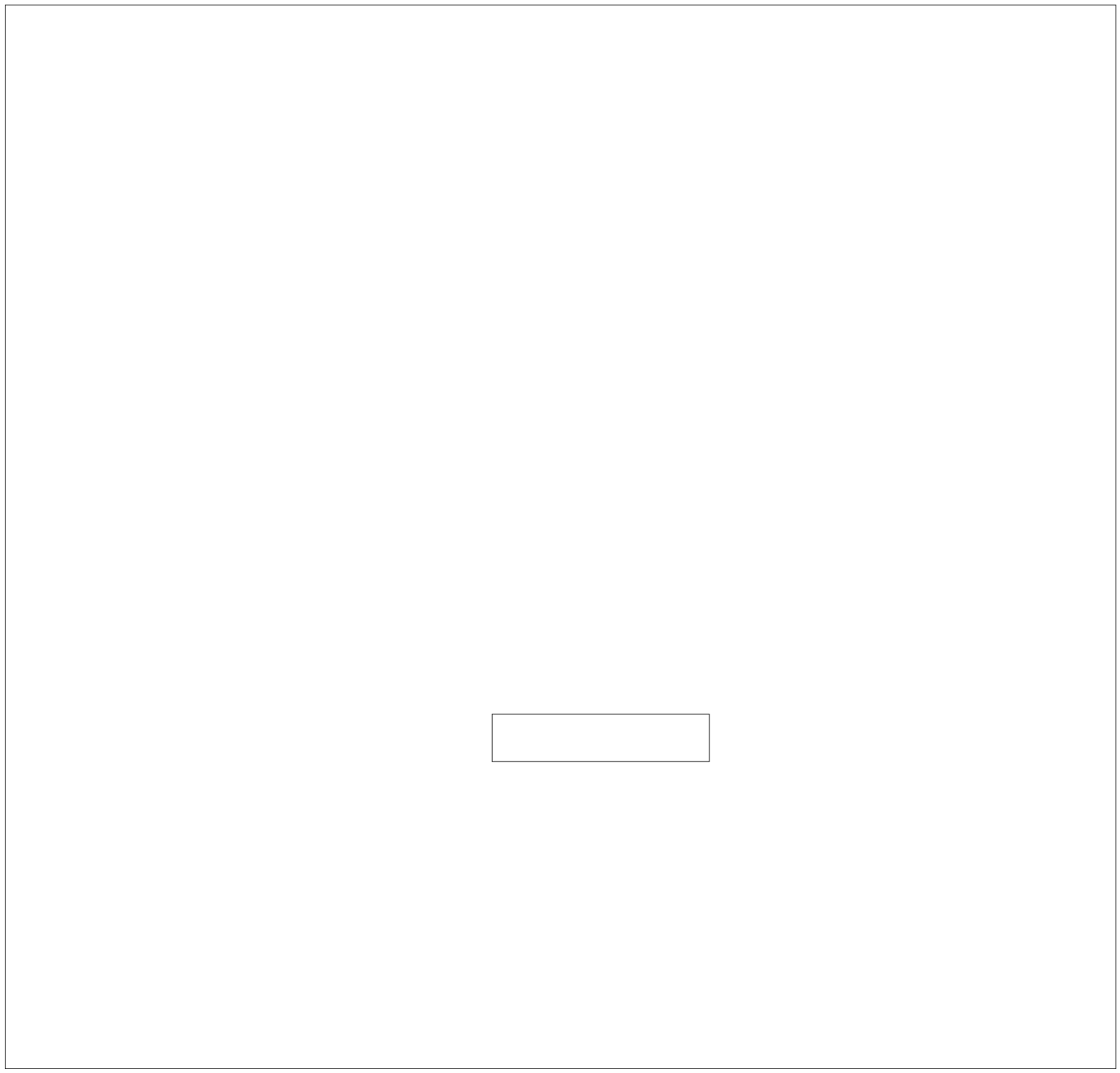

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FINDINGS SINCE THE LAST ISSUE OF NIE 11-12

New Findings:

— Using our new insights into the Soviet process of technology development, we have reassessed the status of Soviet military technology. In many cases we have derived estimates of which military technologies were available to system planners between the late 1970s and 1980s for incorporation into designs of weapon systems which could reach operational forces between the mid-1990s and 2010.

— Since the 1960s, the Soviets have managed the development of certain critical military high technologies using a goal-oriented approach that has many characteristics of a weapons program, but in fact precedes weaponization.

— The Soviets often use a "follower" research strategy, which usually results in lower technology development risks but sometimes stifles indigenous research. They regularly plan the use of inputs from their technology transfer acquisition program to supplement their indigenous military technology development efforts. This allows them to truncate indigenous military research when targeted Western technology is acquired. As a result they are often able to incorporate technology into a weapon system development program, shortly after the United States achieves full production. The Soviets, however, take longer to achieve full production.

— Large amounts of Western military technical and programmatic data available early to Soviet planners allow them to design-to-market as a way of competing. Using this approach they begin similar or offsetting programs about the same time as the United States enters the engineering phase of development, whereas US planners usually receive comparable information on Soviet systems late in the engineering phase. Design to market is a common competitive technique used in the US commercial sector

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Changes to Previous Findings:

— Our improved capability to characterize Soviet programs indicates to us that the Soviets have undertaken a greater number of defense programs than we previously believed. They conduct at

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least 5,000 research programs and have over 300 military products in production per year. They also conduct about 350 military weapon, space, and support system development programs per decade for new and improved equipment. The number of Soviet military research projects in the 1980s is about 20 percent more than those in the 1970s.

— The Soviets in the 1950s adopted a schedule dominant management approach to military system development—much like that used by US commercial corporations for major product development.

— Analysis of over 1,000 military program development schedules shows the Soviets do not try to use high priority—or any other means—to shorten the time it takes to conduct the system engineering phase of the system development process.

— Through the use of the new goal-oriented technology program management style, the use of a follower-research strategy and technology transfer, the Soviets have shortened or accelerated the time for certain technology (not military system) developments. This has allowed them to begin military system development programs earlier than if they used previous management practices and relied solely on indigenous research. New systems have thus reached the field earlier—but not as the result of shortening the military system development schedule.

— Our analysis of military-related research and development costs is now based on a new methodology that estimates resources inputs. Use of the new methodology leads us to conclude that the Soviets are not spending as much as we had previously believed.

— The quality of Soviet scientific research and technology development in some military-related areas is better than we previously assessed.

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ANNEX

Key Bibliography

National Intelligence Estimates that primarily assess Soviet weapons and space capabilities in the near term—to the mid-1990s:

NIE 11-14-85: *Trends and Developments in Warsaw Pact General Purpose Forces* 25X1

NIE 11-3/8-87: *Soviet Forces and Capabilities for Strategic Nuclear Conflict Through the Mid-1990s* 25X1

NIE 11-1-85: *Soviet Space Programs* 25X1

NIE 11-15-84: *Soviet Naval Strategy and Programs Through the 1990s* 25X1

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